

1. T F A programmer must know in advance how many nodes are in a linked-list.
2. T F A linked-list is empty when the head node's value is null.
3. T F A doubly-linked-list is always kept in ascending sequence.
4. T F Every node in a binary tree points to at least one other node.
5. T F The size of a linked-list is not usually known in advance.
6. T F A linked-list can be stored in an array.

Stacks and queues

1. Which element is returned when a stack is popped?
 - A. The element which has been on the stack the longest amount of time.
 - B. The element which has been on the stack for the shortest amount of time.
 - C. The element at the front.
 - D. The element at the top.
2. Name the two major functions of a queue. _____
3. Given the following stack components and the function call for a push operation, write the push function in perfect C++ code. Variable top indicates the top of the stack and 25 is the value to push to the stack.

```
int arr[MAX];
int top = -1;
top = push(arr, top, 25);
```

Recursion

1. What do you call a recursive function's solvable problem?
2. Convert the following function to one that uses recursion.
Make the sign function recursive, but still work the same way.

```
void sign(int n) {
    while (n > 0)
        cout << "No Parking\n";
    --n;
}
```

Binary search trees

1. Insert the following values into an initially-empty binary search tree, in this order:
11, 9, 13, 15, 7, 8, 4, 10

- What is the height of the tree? _____
- How many levels does the tree have? _____
- How many nodes are in the root-node's left subtree? _____
- How many leaf nodes are there? _____

2. The post-order traversal of a BST is useful for which of the following?

- inserting nodes
- removing/deleting all nodes
- checking for duplicate nodes
- displaying the nodes in reverse order

Hash tables

1. An empty hash table is below with size 10 and hash function **hash(x) = x mod 10**. Linear probing is used to resolve collisions. Insert the following keys into the table, in this order. 32, 55, 14, 24, 19, 82, 9

0	1	2	3	4	5	6	7	8	9

2. An empty hash table is below with size 7 and hash function **hash(x) = (3x + 4) mod 7**.

Linear probing is used to resolve collisions.

Insert the following keys into the table, in this order. 3, 4, 7, 25

0	1	2	3	4	5	6

Algorithm efficiency

1. What is the expected number of comparisons to find a key value in each of the following data structures. Assume each has a size of n . Give your answer in terms of n . (You may use Big-O notation)

a. Linked list _____

b. Binary search tree _____

c. Hash table _____

d. Unordered array _____

e. Ordered array _____